

Data Collection Activity - The Ball Bounce Problem

The data we have collected and graphed is a distance vs. time scatterplot of a bouncing racquetball. The data from each bounce appears to be quadratic, so each group will attempt to fit their data with a quadratic function in its vertex form:

$$y = a(x - h)^2 + k$$

1. By tracing on the scatterplot, you should be able to obtain values for \mathbf{h} and \mathbf{k} for your bounce.. Round these values to the nearest hundredth and record them below.

Note: The values for h and k may not be “exactly” on a data point. The vertex of the parabola may occur “between” two data points.

h = k =

2. Explain what the values of \mathbf{h} and \mathbf{k} represent to the problem. Be specific!

h represents

k represents _____

3. Let's first find the value of **a** for our equation by *trial and error*. Enter the **vertex form** of your equation using the **h** and **k** values above in **Y1** of your calculator along with an initial guess for the value of **a**. Experiment until you find a value of **a** that provides a good fit for the data. Record your value of **a** below.

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4. Now, let's find the value of **a** with *algebra*. Select another ordered pair from your scatterplot (that is not close to the vertex,) and substitute these values in for **x** and **y** in your equation and solve for **a**. Show your work below.

5. Record your final function: $y =$ _____

6. It is also possible to express any quadratic function in the general form:

$$y = ax^2 + bx + c$$

To determine the values of b and c (since a is identical to that found in part 4 above), expand your equation in part 5, and collect like terms. Round all values to the nearest hundredth. Show this work below

7. To check your work above, enter this **general form** of the quadratic function into **Y2** of your calculator, and see if it fits the data as well as your function in **Y1**. If not, find your mistake!

8. As another check, perform a *quadratic regression* (QuadReg) on your data which will allow your calculator to find the best-fitting quadratic function (in General Form) through the set of data. Again, round all values to the nearest hundredth and record this equation below. These values of a , b , and c should be close to your answer to part 6. Are they?

$y =$ _____

9. In problem 6 of this worksheet, we transformed the equation of the parabola from **vertex form** to **general form**. For practice, let's take the **general form** from the quadratic regression equation above in problem 8, and put it into **vertex form**. This means we have to find the values for h and k .

Hint: From our earlier algebra, we have shown that $h = -\frac{b}{2a}$, and then k is equal to the value of h substituted into the function for x and evaluated. Evaluate h and k using this procedure. Show your calculations below.

$h =$ _____ $k =$ _____ **Vertex Form:** $y =$ _____